

COMANDO DA AERONÁUTICA
CENTRO DE INVESTIGAÇÃO E PREVENÇÃO DE
ACIDENTES AERONÁUTICOS



FINAL REPORT
A-036/CENIPA/2022

OCCURRENCE:	ACCIDENT
AIRCRAFT:	PT-BOK
MODEL:	PA-28-140
DATE:	21MAR2022



NOTICE

According to the Law n  7565, dated 19 December 1986, the Aeronautical Accident Investigation and Prevention System – SIPAER – is responsible for the planning, guidance, coordination, and execution of the activities of investigation and prevention of aeronautical accidents.

The elaboration of this Final Report was conducted considering the contributing factors and hypotheses raised. The report is, therefore, a technical document which reflects the result obtained by SIPAER regarding the circumstances that contributed or may have contributed to triggering this occurrence.

The document does not focus on quantifying the degree of contribution of the distinct factors, including the individual, psychosocial or organizational variables that conditioned the human performance and interacted to create a scenario favorable to the accident.

The exclusive objective of this work is to recommend the study and the adoption of provisions of preventative nature, and the decision as to whether they should be applied belongs to the President, Director, Chief or the one corresponding to the highest level in the hierarchy of the organization to which they are being forwarded.

This Final Report has been made available to the ANAC and the DECEA so that the technical-scientific analyses of this investigation can be used as a source of data and information, aiming at identifying hazards and assessing risks, as set forth in the Brazilian Program for Civil Aviation Operational Safety (PSO-BR).

This Report does not resort to any proof production procedure for the determination of civil or criminal liability, and is in accordance with Appendix 2, Annex 13 to the 1944 Chicago Convention, which was incorporated in the Brazilian legal system by virtue of the Decree n  21713, dated 27 August 1946.

Thus, it is worth highlighting the importance of protecting the persons who provide information regarding an aeronautical accident. The utilization of this report for punitive purposes maculates the principle of “non-self-incrimination” derived from the “right to remain silent” sheltered by the Federal Constitution.

Consequently, the use of this report for any purpose other than that of preventing future accidents, may induce to erroneous interpretations and conclusions.

N.B.: This English version of the report has been written and published by the CENIPA with the intention of making it easier to be read by English speaking people. Considering the nuances of a foreign language, no matter how accurate this translation may be, readers are advised that the original Portuguese version is the work of reference.

SYNOPSIS

This is the Final Report of the 21 March 2022 accident with the PA-28-140 aircraft, registration marks PT-BOK. The occurrence was typified “[SCF-PP] Engine failure or malfunction | With propeller.”

Approximately ten minutes into an instruction flight in the region of *Bragança Paulista*, State of *São Paulo*, the aircraft suddenly experienced strong vibration and loss of performance of the engine. The pilots made an emergency landing in an open area of a gated community located at a distance of 4.9 NM from the city's aerodrome.

The aircraft sustained substantial damage, and both crewmembers suffered serious injuries.

For being the USA the State of manufacture of the aircraft, the NTSB (National Transportation Safety Board) designated an accredited representative for participation in the investigation of the accident.



TABLE OF CONTENTS

GLOSSARY OF TECHNICAL TERMS AND ABBREVIATIONS	5
1. FACTUAL INFORMATION.....	6
1.1. History of the flight.....	6
1.2. Injuries to persons.....	6
1.3. Damage to the aircraft.....	6
1.4. Other damage.....	7
1.5. Personnel information.....	7
1.5.1. Crew's flight experience.....	7
1.5.2. Personnel training.....	7
1.5.3. Category of licenses and validity of certificates.....	7
1.5.4. Qualification and flight experience.....	8
1.5.5. Validity of medical certificate.....	8
1.6. Aircraft information.....	8
1.7. Meteorological information.....	14
1.8. Aids to navigation.....	15
1.9. Communications.....	15
1.10. Aerodrome information.....	15
1.11. Flight recorders.....	15
1.12. Wreckage and impact information.....	15
1.13. Medical and pathological information.....	17
1.13.1. Medical aspects.....	17
1.13.2. Ergonomic information.....	17
1.13.3. Psychological aspects.....	17
1.14. Fire.....	17
1.15. Survival aspects.....	17
1.16. Tests and research.....	17
1.17. Organizational and management information.....	19
1.18. Operational information.....	20
1.19. Additional information.....	20
1.20. Useful or effective investigation techniques.....	20
2. ANALYSIS.....	20
3. CONCLUSIONS.....	22
3.1. Findings.....	22
3.2. Contributing factors.....	22
4. SAFETY RECOMMENDATIONS	23
5. CORRECTIVE OR PREVENTATIVE ACTION ALREADY TAKEN.....	23

GLOSSARY OF TECHNICAL TERMS AND ABBREVIATIONS

AFIS	Aerodrome Flight Information Service
ANAC	Brazil's National Civil Aviation Agency
CENIPA	Brazil's Aeronautical Accidents Investigation and Prevention Center
CIV	Pilot Logbook
CMA	Aeronautical Medical Certificate
COM	Maintenance Organization Certificate
CVA	Airworthiness Verification Certificate
DCTA	Department of Science and Aerospace Technology
FOD	Foreign Object Debris/Damage
IAE	Institute of Aeronautics and Space
IAM	Annual Maintenance Inspection
IFRA	IFR Flight Rating (Airplane)
IN	Instructor
INVA	Flight Instructor Rating (Airplane)
IS	Supplementary Instruction
METAR	Routine Meteorological Aerodrome Report
MLTE	Multi-Engine Land Airplane Class Rating
MNTE	Single-Engine Land Airplane Class Rating
NTSB	USA's National Transportation Safety Board
OS	Service Order
PCM	Commercial Pilot License (Airplane)
PN	Part Number
PRI	Private Aircraft Registration Category (Instruction)
PPR	Private Pilot License (Airplane)
RBAC	Brazilian Civil Aviation Regulation
SBBP	ICAO location designator - <i>Arthur Siqueira State-Aerodrome, Bragança Paulista, State of São Paulo</i>
SBMT	ICAO location designator - <i>Campo de Marte Aerodrome, São Paulo, State of São Paulo</i>
SD4V	ICAO location designator - <i>Aerodrome of Estância de Socorro, State of São Paulo</i>
SERIPA IV	4 th Regional Service for the Investigation and Prevention of Aeronautical Accidents
SN	Serial Number
UTC	Universal Time Coordinated

1. FACTUAL INFORMATION.

Aircraft	Model: PA-28-140 Registration: PT-BOK Manufacturer: Piper Aircraft.	Operator: <i>Charlie O-Aeronautical Training Center Ltda.</i>
Occurrence	Date/time: 21MAR2022 - 13:40 UTC Location: Open area inside a private gated-community Lat. . 22°53'54"S Long. 046°33'22"W Municipality – State: <i>Bragança Paulista – State of São Paulo.</i>	Type(s): [SCF-PP] Powerplant failure or malfunction

1.1. History of the flight.

At around 13:30 UTC, the aircraft took off from SBBP (*Arthur Siqueira State-Aerodrome, Bragança Paulista, State of São Paulo*) for a local instruction-flight in the SBR-460 reserved area, with 02 POB (an Instructor and a PIC under supervision).

The flight was proceeding in VMC and, after approximately ten minutes, the aircraft's engine experienced a sudden strong vibration, with subsequent loss of performance. The crew made an emergency landing in an open area located inside a gated community at a distance of 4.9 NM from the aerodrome of *Bragança Paulista*.

The aircraft sustained substantial damage, and both crewmembers suffered serious injuries.



Figure 1 - Aircraft after coming to a complete stop.

1.2. Injuries to persons.

Injuries	Crew	Passengers	Others
Fatal	-	-	-
Serious	2	-	-
Minor	-	-	-
None	-	-	-

1.3. Damage to the aircraft.

The aircraft sustained substantial damage to the entire landing gear, fuselage, wings, right-hand flap, engine, and windshield.

One of the propeller blades fractured and lost approximately 50% lengthwise. The other blade sustained damage due to impact.



Figure 2 - Close-up image of the damage sustained by the aircraft, and detail of the fractured propeller.

1.4. Other damage.

NIL.

1.5. Personnel information.

1.5.1. Crew's flight experience.

Flight Experience		
	IN	PIC under supervision
Total	740:50	156:05
Total in the last 30 days	24:50	01:00
Total in the last 24 hours	00:10	00:10
In this type of aircraft	590:50	100:30
In this type in the last 30 days	19:50	01:00
In this type in the last 24 hours	00:10	00:10

N.B.: data on flight time obtained through records of the pilots' CIV (Digital Pilot-Logbook).

1.5.2. Personnel training.

The IN did his PPR course (Private Pilot – Airplane) in 2016, at the *Aeroclub de São Paulo*, State of *São Paulo*, and earned his INVA license (Flight Instructor - Airplane) in January 2020.

The other pilot, who was the PIC under supervision, did his PPR course in 2020, at the *Aeroclub de Catanduva*, State of *São Paulo*, and was under instruction for the obtainment of his INVA license.

1.5.3. Category of licenses and validity of certificates.

The IN held a PCM License (Commercial Pilot - Airplane), and had valid ratings for Single-Engine Land Airplane (MNTE), Multi-Engine Land Airplane (MLTE), Instrument Flight - Airplane (IFRA), and Flight Instructor - Airplane (INVA).

The PIC under supervision held a PCM License, as well as valid MNTE and IFRA ratings.

1.5.4. Qualification and flight experience.

The IN was qualified and had experience in the type of flight, with more than 183 hours of flight time as an aircraft instructor.

The PIC under supervision was qualified, and that instruction was the third one of his aircraft flight-instructor preparation course.

1.5.5. Validity of medical certificate.

The pilots held valid CMAs (Aeronautical Medical Certificates).

1.6. Aircraft information.

The SN 28-24721 airplane was a product manufactured by Piper Aircraft in 1968. It was registered in the PRI* category (*Private Aircraft Registration Category - Instruction).

Its CVA (Airworthiness Verification Certificate) was valid.

The referred airplane was equipped with a *Lycoming* conventional engine (model O-320-E2A, SN L-230019-27A), and with a *Sensenich* propeller (model 74DM6-0-58, SN K-26595).

The SN K-26595 propeller, which initially equipped the PT-DCW aircraft, was installed in the PT-BOK on 02 December 2021.

It was not possible to determine the weight and balance values of the aircraft, as the pertinent control sheet was not up to date, because of a painting accomplished on the aircraft after the last documented weighing kept by the operator. The information contained in the relevant form appears in detail in the items 1.17 and 1.18 of this report.

The aircraft had a total of 4,661 flight hours of flight, of which 157 hours and 20 minutes were flown after the last inspection for obtainment of the Certificate of Airworthiness Verification (CVA), and 13 hours and 10 minutes after the last 100-hour inspection.

The engine had a total of 4,676 hours and 55 minutes of flight time, being 1,094 hours and 05 minutes after the last overhaul, and 13 hours and 10 minutes after the last 100-hour inspection.

The SN K-26595 propeller had a total of 6,163 hours and 30 minutes of flight time, being 440 hours and 36 minutes after the latest overhaul, and 13 hours and 10 minutes after the latest 100-hour inspection.

The records of the airframe, engine, and propeller logbooks were out of date.

The latest airframe logbook, opened on 11 September 2020, did not have any annotations on the pages for monthly usage records since its opening.

Similarly, the latest engine logbook, opened on 11 September 2020, did not have any annotations on the pages for monthly usage records since its opening.

The latest logbook of the SN K-26595 propeller, opened on 14 April 2011, had annotations on the pages for the monthly usage records, but its most recent record had been logged in December 2019.

The ANAC's IS (Supplementary Instruction) nº 43.9-003, Revision B, of 20 February 2020, in its item 5.6.2, prescribed that the updating of part I of the logbooks had, obligatorily, to be entered by the fifth day of the following month, as follows:

The updating of Part I of airframe, engine, and propeller logbooks must be accomplished by the fifth day of the following month, whenever there is a change in the operating times mentioned in paragraphs 4.4 and 4.5 of this IS. Therefore, if an aircraft, engine, or propeller operates after an inactive period of more than one month, such inactivity is to be mentioned in a single line in the *Monthly Control of*

Part I field of the respective logbooks. For example: Hours not totaled from 30/04/02 to 30/09/02 – due to AML.

With regard to the inspections of the SN K-26595 propeller during the time it equipped the PT-DCW aircraft and on the occasion it was transferred to the PT-BOK, one collected the following items of information (Figure 3).

ITEM	DATA	EVENTO	AERONAVE INSTALADA	REGISTRO	HORAS TOTAIS DA HÉLICE	HORAS APÓS REVISÃO GERAL	HORAS TOTAIS (AERONAVE)	OFICINA	OS
HÉLICE S/N K26595	19/08/2020	ENTRADA EM REVISÃO GERAL	PT-DCW	ATV-1996/2020 OS 1996/2020	5722,9	0,0	5742 (PT-DCW)	AEROTÉCNICA VAVÁ	1996/2020
HÉLICE S/N K26595	25/08/2020	SAÍDA DA REVISÃO GERAL	PT-DCW	ATV-1996/2020 OS 1996/2020	5722,9	0,0	5742 (PT-DCW)	AEROTÉCNICA VAVÁ	1996/2020
HÉLICE S/N K26595	17/09/2020	CERTIFICAÇÃO DE VERIFICAÇÃO DE AERONAVEGABILIDADE (CVA)	PT-DCW	CADERNETAS DE CÉLULA E HÉLICE	5722,9	0,0	5742 (PT-DCW)	MARTE UPDATE	2499/20
HÉLICE S/N K26595	17/09/2020	REGISTRADO NAS CADERNETAS DE CÉLULA E HÉLICE A REVISÃO GERAL DA HÉLICE	PT-DCW	CADERNETAS DE CÉLULA E HÉLICE	5722,9	0,0	5742 (PT-DCW)	MARTE UPDATE	2499/20
HÉLICE S/N K26595	14/04/2021	INSPEÇÃO DE 50/100/500/1000 HORAS	PT-DCW	CADERNETAS DE CÉLULA E HÉLICE	5751,8	28,9	5770,9 (PT-DCW)	MARTE UPDATE	2835/21
HÉLICE S/N K26595	18/06/2021	INSPEÇÃO DE 50 HORAS	PT-DCW	CADERNETAS DE CÉLULA E HÉLICE	5801,7	78,8	5820,8 (PT-DCW)	MARTE UPDATE	3190/21
HÉLICE S/N K26595	11/08/2021	INSPEÇÃO DE 50/100 HORAS	PT-DCW	CADERNETAS DE CÉLULA E HÉLICE	5855,1	132,2	5874,2 (PT-DCW)	MARTE UPDATE	3353/21
HÉLICE S/N K26595	NÃO LANÇADA	INSPEÇÃO DE 50H	PT-DCW	NÃO LANÇADA	NÃO LANÇADA	NÃO LANÇADA	NÃO LANÇADA	NÃO LANÇADA	NÃO LANÇADA
HÉLICE S/N K26595	28/09/2021	INSPEÇÃO DE 50/100/200 HORAS / 90 DIAS/ 4 MESES / CVA	PT-DCW	CADERNETAS DE CÉLULA E HÉLICE	5945,8	222,9	5964,9 (PT-DCW)	MARTE UPDATE	3489/21
HÉLICE S/N K26595	05/11/2021	INSPEÇÃO DE 50 HORAS	PT-DCW	CADERNETAS DE CÉLULA E HÉLICE	5995	272,1	6014,1 (PT-DCW)	MARTE UPDATE	3610/21
-	01/12/2021	INÍCIO DA INSPEÇÃO DE 100 HORAS DA AERONAVE PT-BOK	PT-BOK	CADERNETAS DE CÉLULA E HÉLICE	-	-	4553,7 (PT-BOK)	MARTE UPDATE	3706/21
HÉLICE S/N K26595 E S/N K13087	02/12/2021	TROCA DE AERONAVE (REMOÇÃO DO PT-DCW E INSTAÇÃO NO PT-BOK)	PT-DCW/PT-BOK	CADERNETAS DE CÉLULA E HÉLICE	6045*	332,1**	6056,8 (PT-DCW)	MARTE UPDATE	3706/21 E 3714/21

Figure 3 - Chronological order of the inspections of the SN K-26595 propeller on the PT-DCW and at the change to the PT-BOK.

(*) maintenance logbooks' records showing 7.3 hours more than the hours logged in the aircraft logbook (the correct number should be 6,037.7 hours).

(**) maintenance logbooks' records showing 17.3 hours more than the hours logged in the logbook (the correct number should be 314.8).

On 19 August 2020, the *Marte Updates & Avionics Ltda.* maintenance organization - (COM nº 1404-01/ANAC) outsourced the overhaul service of the SN K-26595 propeller (model 74DM6-0-58) to *Aerotécnica Vavá, Specialized in Governor Propellers and Essays* (COM No. 8004-03/ANAC), a company certified for the provision of the maintenance in question.

On the occasion of the receipt, one observed no visual damage to the propeller, which had a total of 5,722 hours and 54 minutes TSN (time since new).

In the dimensional inspection, in the non-destructive liquid penetrant testing, and in the overhaul of the SN K-26595 propeller, one found no discrepancies. The propeller was compliant with the continued airworthiness requirements, and approved for return to service on 25 August 2020.

The propeller underwent an airworthiness verification inspection on 17 September 2020, and received a declaration of compliance with the continued airworthiness requirements on that date.

After the overhaul, and until its transference from the PT-DCW to the PT-BOK on 02 December 2021, the SN K-26595 propeller operated for 314 hours and 48 minutes. During that period, in accordance with the PT-DCW airframe's inspection calendar, the propeller

should have undergone six 50-hour inspections and three 100-hour inspections (of those, only five 50-hour inspections and three 100-hour inspections were logged).

Relatively to the service of propeller change between PT-DCW and PT-BOK aircraft, one gathered the following information:

- On 01 December 2021, the PT-BOK aircraft underwent inspection, at the *Marte Updates & Avionics Ltda.* (Service Order n° 3706/21).

In the abovementioned OS, it was not possible to verify whether the SN K-26595 propeller underwent inspection, since only the verification of the PN M74DM-O-58, SN K-13087 propeller had been documented (i.e., the propeller previously installed), with information that the service performed was exclusively the removal and installation of the aforementioned propellers (Figure 4).

PÁGINA: 2

MARTE **ORDEM DE SERVIÇO** O.S.Nº 3706 /21
Form. MUP 012 Rev. 16/03/2021

Modelo:	S/N:	TSM:	FSO:	CSW:	Ano Fab:	PREFIXO:	PT-BOK
PA-28-140	28-24721	45537	-	-	1968		
Operador: CHARLIE Q-AERONAUTICAL TRAINING CENTER LTDA						Comercial:	LUZIA
Entrada:	01/12/2021	Previsão de Saída:	00/01/1900	Saída:	02/14/21	Localidade:	SBMT
Retrabalho: <input type="checkbox"/> Sim <input checked="" type="checkbox"/> Não							

INSPEÇÃO NO ESTADO GERAL DO PRODUTO: (X) ACEITÁVEL () COMENTÁRIOS

DESCREVER O RECEBIMENTO: Serviços executados no aeronave.

ITEM	S/N	REMOÇÃO	INSTALAÇÃO		
3					
EFETUAR CALIBRAGEM DOS PNEUS					
<i>Effectuar a calibragem dos pneus de acordo com o APM 753-586</i>					
ITEM	DESCRIÇÃO	P/N	S/N	P/N	S/N
ITEM	DESCRIÇÃO	P/N	S/N	P/N	S/N
01	Verificar Hélice M74DM-O-58	M74DM-O-58	K13087		
02	Retirar Hélice	M74DM-O-58	K13087	M74DM-O-58	K-26595

Removida a hélice P/N M74DM-O-58 S/N K13087 e instalada a hélice P/N M74DM-O-58 S/N K-26595

Figure 4 - Service Order n° 3706/21 (100-hour inspection of the PT-BOK aircraft).

- Furthermore, on the page referring to the 50- and 100-hour inspections, one observed that the first tasks listed referred to verifying the condition of the installed propeller.

In this Service Order, it was not possible to determine the time when the inspection was performed, whether before or after replacement and, thus, which propeller was inspected. Besides, the records had erasures, as they had originally been printed with information related to the propeller removed (Figure 5).

MARTE		MARTE UPDATES & AVIONICS	
FICHA DE INSPEÇÃO		PIPER CHEROKEE PA-28-140, -150, -160, -180; 235; & PA-28R-180/200	
Ficha de Inspeção extraída do Piper Airplane Maintenance Manual 753-586 revisado em 30 de novembro de 2019.			
PREFIXO	PT-BOK	O.S. Nº	3706/2021
DATA DE ENTRADA:		01/12/2021	
INSPEÇÃO DE: () 50 HORAS (X) 100 HORAS () CVA () ESPECIAL			
Marca	Célula	Motor	Hélice
Modelo	PA-28-140	LYCOMING	SENENICH
Nº de Série	28-24721	O-320-E2A	M74DM-0-58
Horas Totais	(4552.4) 4553.7	L-23019-27A	(K13087) K-26595
Após Revisão	NOVO	(4552.4) 4553.7	(4904.8) 6045.0
		(1880.4) 970.9	(970.6) 332.1
Avião Acidentado		C.V.A.	
Sim	Não	X	Sim
			Não
			X
			Sim
			Não
			X
Consulte as Notas 1, 2, 3 e 4 antes de efetuar as inspeções a seguir.			
Natureza da Inspeção		Intervalo (horas)	Mecânico Inspetor
A. GRUPO DA HÉLICE		50	100
CUIDADO: TOMAR UM CUIDADO EXTREMO AO GIRAR A HÉLICE COM AS MÃOS; A HÉLICE PODE RETROCEDER. ANTES DE GIRAR A HÉLICE, CERTIFIQUE-SE QUE AS CHAVES DE AMBOS OS MAGNETOS ESTÃO DESLIGADAS (ATERRADAS). SE OS MAGNETOS NÃO ESTIVEREM ATERRADOS, O GIRAR DA HÉLICE PODE ACIONAR O MOTOR.			
1	Inspeção o spinner e a placa traseira quanto a trincas, dentes, parafusos faltando e segurança.		
2	Inspeção as pás quanto a entalhes e trincas.		
3	Somente no PA-28-235, se a hélice instalada for de velocidade constante: cheque quanto a vazamentos de graxa e óleo.	N/A	
4	Somente no PA-28-235, se a hélice instalada for de velocidade constante: lubrifique a hélice conforme a Carta de Lubrificação, Seção II.	N/A	
5	Inspeção os suportes de instalação do spinner quanto a trincas e segurança.		
6	Inspeção os parafusos de instalação da hélice quanto a segurança e frenagem. Verifique o torque e torne a aplicar a frenagem adequada caso freno esteja rompido.		
7	Somente no PA-28-235, se a hélice instalada for de velocidade constante: inspeção as partes do cubo quanto a trincas e corrosão.	N/A	
8	Somente no PA-28-235, se a hélice instalada for de velocidade constante: gire as pás da hélice e cheque quanto ao aperto no tubo guia do cubo. (Consulte a Seção VIII).	N/A	
9	Inspeção toda a hélice e o spinner quanto a segurança, striito, trincas, deterioração, desgaste e instalação correta.		

Figure 5 - Work order with erasures, and first inspection tasks.

- On 02 December 2021, the PT-DCW aircraft landed in SBMT at 15:44 UTC, still equipped with the SN K-26595 propeller.
- The removal of the SN K-26595 propeller from the PT-DCW aircraft was written down in OS no. 3714/21 on 02 December 2021. In the referred OS, one found that the service was performed on 02 December 2021, one day after the beginning of the inspections of the PT-BOK.
- It was not possible to confirm whether the SN K-26595 propeller was inspected, since the records entered by the service provider included exclusively the replacement of the mentioned propeller (Figure 6).

MARTE		ORDEM DE SERVIÇO		O.S. Nº 3714 /21	
FICHA DE INSPEÇÃO		Form. MUP-012		Rev. 16/03/2021	
Modelo:	S/N:	T/S:	T/SO:	C/N:	Ano Fab.
PA-28-140	28-24713			N/A	1964
PREFIXO:			PT-DCW		
Entrada:			02/12/2021		
Previsão de Saída:			02/12/2021		
Retrabalho:			[] Sim [X] Não		
INSPEÇÃO NO ESTADO GERAL DO PRODUTO: (X) ACEITÁVEL () COMENTÁRIOS					
DESCREVER O RECEBIMENTO: Serviços executados no aeronave.					
ITEM	DESCRIÇÃO	P/N	S/N	DESCRIÇÃO	S/N
1	VERIFICAR HÉLICE P/N: 74DMG-0-58 E S/N K-26595			Substituição da hélice de acordo com Ann. m. 743-586 Rev. seguinte de 30/11/21	
		REMOÇÃO		INSTALAÇÃO	
ITEM	DESCRIÇÃO	P/N	S/N	P/N	S/N
1	Hélice	74DMG-0-58	K-26595	M74DM-0-58	K-13087

Figure 6 - Service order nº 3714/21 (replacement of the PT-DCW aircraft propeller).

In addition to the fact that it was not possible to determine, by means of the aforementioned Service Orders, whether the inspection of the SN K-26595 propeller had at all taken place, the logbook of the said propeller did not have any pertinent records concerning the referred inspection.

On the page 39 of the logbook, one could see that the 50-hour inspection took place on 05 November 2021, and on the page 40, there were the records of the propeller replacement performed on 02 December 2021. The next records of an inspection were entered only on 15 March 2022, three months after the replacement of the propeller. No information concerning the maintenance of the SN K-26595 propeller was logged during the inspection at which the installation of the propeller was executed.

Moreover, on 02 December 2021, the 100-hour inspection was logged in the logbook of the SN K-13087 propeller, with its label pasted on a page preceding the one on which the blade replacement was logged, corroborating the time line of the events.

In relation to the PT-BOK inspections, one gathered the following information (Figure 7):

ITEM	DATA	EVENTO	AERONAVE INSTALADA	REGISTRO	HORAS TOTAIS DA HÉLICE	HORAS APÓS REVISÃO GERAL	HORAS TOTAIS (AERONAVE)	OFICINA	OS
HÉLICE S/N K13087	12/11/2021	CERTIFICAÇÃO DE VERIFICAÇÃO DE AERONAVEGABILIDADE (CVA)	PT-BOK	CADERNETA DE CÉLULA E HÉLICE	4503,7	1331,4	4503,7 (PT-BOK)	MARTE UP DATE	3630/21
HÉLICE S/N K13087	01/12/2021	INÍCIO DA INSPEÇÃO DE 100 HORAS DA AERONAVE PT-BOK	PT-BOK	CADERNETAS DE CÉLULA E HÉLICE	4503,7	1331,4	4503,7 (PT-BOK)	MARTE UPDATE	3706/21
HÉLICE S/N K13087	02/12/2021	INSPEÇÃO DE 100H/ 4 MESES	PT-BOK	CADERNETA DE CÉLULA E HÉLICE	4455,4 (S/N K13087)	1283,1 (S/N K13087)	4553,7 (PT-BOK)	MARTE UPDATE	3706/21
HÉLICE S/N K26595 E S/N K13087	02/12/2021	TROCA DE AERONAVE (REMOÇÃO DO PT-DCW E INSTAÇÃO NO PT-BOK)	PT-DCW/PT-BOK	CADERNETAS DE CÉLULA E HÉLICE	6045* (S/N K26595)	332,1** (S/N K26595)	4553,7 (PT-BOK)	MARTE UPDATE	3706/21 E 3714/21
HÉLICE S/N K26595	03/01/2022	ENTRADA NA PINTURA	PT-BOK	DIÁRIO DE BORDO	6074,9	352,0	4590,9 (PT-BOK)	PARTICULAR	NIL
HÉLICE S/N K26595	10/02/2022	SAÍDA DA PINTURA	PT-BOK	DIÁRIO DE BORDO	6074,9	352,0	45890,9 (PT-BOK)	PARTICULAR	NIL
HÉLICE S/N K26595	NÃO LANÇADA	INSPEÇÃO DE 50H	PT-BOK	NÃO LANÇADA	NÃO LANÇADA	NÃO LANÇADA	NÃO LANÇADA	NÃO LANÇADA	NÃO LANÇADA
HÉLICE S/N K26595	15/03/2022	INSPEÇÃO DE 50/100/500 HORAS	PT-BOK	CADERNETA DE CÉLULA E HÉLICE	6150,4	427,5	4647,9 (PT-BOK)	MARTE UPDATE	3930/22
HÉLICE S/N K2659	21/03/2022	ACIDENTE	PT-BOK	ACIDENTE	6163,5	440,6	4661 (PT-BOK)	ACIDENTE	NIL

Figure 7 - Chronological order of inspections on the PT-BOK aircraft.

(*) entry in the maintenance logbooks of 7.3 hours more than those recorded in the logbook (the correct number should be 6,037.7 hours).

(**) entry in maintenance logbooks of 17.3 hours more than those entered in the logbook (the correct figure should be 314.8 hours).

The last inspection for issuance of the Airworthiness Verification Certificate (CVA) took place on 12 November 2021 at the *Marte Updates* maintenance organization, in the city of São Paulo. At that inspection, the new propeller of the aircraft had not yet been replaced. On the occasion, the propeller equipping the aircraft was the one manufactured by the company Sensenich Propeller (model 74DM6-0-58, SN K-1308). By the time of the accident, the aircraft's airframe had flown 157 hours and 18 minutes after the said inspection.

After the installation of the SN K-26595 propeller, the PT-BOK flew 107 hours and 18 minutes. During that period, according to the airframe's inspection calendar, the propeller should have undergone two 50-hour inspections and one 100-hour inspection. Only one 50-hour inspection and one 100-hour inspection were registered in the pertinent logbook.

On 03 January 2022, at 13:43 UTC, the aircraft performed a ferry flight from SBBP to SD4V (Aerodrome of *Socorro*, State of *São Paulo*) in order undergo a painting service in a private maintenance hangar. The aircraft remained in that location during the execution of the proposed service, and returned to SBBP on 10 February 2022, at 22:00 UTC.



Figure 8 - Former livery of the PT-BOK.

The professional that painted the aircraft was not certified by the ANAC. According to the very painter, there was no one to supervise the painting service. Besides, no documentation was available to prove the assistance of a qualified professional during the execution of the service.

The Brazilian Civil Aviation Regulation nº 43 (RBAC-43), EMD05, in its section 43.3, letter (d), dealing with the execution of maintenance, preventative maintenance, and changes under the supervision of an aeronautical maintenance mechanic qualified by the ANAC:

(d) A person, working under the supervision of an aircraft maintenance mechanic, may perform maintenance, preventative maintenance, as well as changes, for which his/her supervisor is authorized by the ANAC, on the condition that his/her supervisor monitors the execution of the work in person, to the extent necessary for ensuring that such work is being done appropriately. Such supervisor as to remain readily available to answer in person any questions from the person doing the work. Nevertheless, this paragraph does not authorize the conduction of any inspections required by the RBAC-91, or any inspections performed after a major repair or major change. (Wording given by Resolution nº 612, of 03/09/2021)

There were no records concerning the painting service delivered to the PT-BOK in the airframe logbook, and the painter reported that the propeller was not removed for the painting of the aircraft.

After the comprehensive painting service, the aircraft was not weighed, nor was its weight and balance calculated.

The RBAC-91, EMD03, in its Subpart E, section 91.423, letter c, item 2, had provisions concerning aircraft weight and balance, as highlighted below:

91.423 Aircraft weight and balance

(a) Aircraft whose approved manuals define time intervals between consecutive weighings shall be weighed in accordance with such manuals.

(b) Regional transport and transport category aircraft, multi-engine aircraft with jet engines of any Category, and transport category rotary-wing aircraft, when they do not have weighing intervals defined in their approved manuals, shall be weighed every 5 years.

(c) Except as provided in paragraphs (a) and (b) of this section, any aircraft shall be weighed:

(1) whenever there is doubt as to the accuracy of its weight and balance; and

(2) after having been subjected to maintenance services and changes that may have altered its weight, such as general painting, major repairs, major alterations, configuration changes, etc. (*emphasis added*).

On 15 March 2022, 57 hours after receiving the painting, the aircraft underwent the last inspection before the accident (type 100-hours) at the premises of *Marte Updates & Avionics Ltda*.

In both the OS nº 3930/2022 (Figure 9) and the Component Control Map (Figure 10), dated 15 March 2022, one mistakenly logged that the SN K-13087 propeller was still equipping the PT-BOK aircraft.

MARTE		MARTE UPDATES & AVIONICS	
*** UPDATES & AVIONICS		FICHA DE INSPEÇÃO	
CONTR. MAR. DE. MARAC		PIPER CHEROKEE PA-28-140, -150, -160, -180; 235; & PA-28R-180/200	
Ficha de Inspeção extraída do Piper Airplane Maintenance Manual 753-586 revisado em 30 de novembro de 2019.			
PREFIXO	PT-BOK	O.S. Nº	3930/2022
		DATA DE ENTRADA:	03/03/2022
INSPEÇÃO DE: () 50 HORAS (X) 100 HORAS () CVA () ESPECIAL			
Marca	Célula	Motor	Hélice
PIPER	PA-28-140	LYCOMING	SENSENICH
Modelo	28-24713	O-320-E2A	M74DM-0-58
Nº de Série	4647,9	L-23019-27A	K13087
Horas Totais	N/A	4647,9	4647,9
Após Revisão		1066,1	1476,6
Avião Acidentado		C.V.A.	
Sim	Não	Sim	Não
	X		X
		Especial	
		Sim	Não
			X
Consulte as Notas 1, 2, 3 e 4 antes de efetuar as inspeções a seguir.			
Natureza da Inspeção		Intervalo (horas)	
A. GRUPO DA HÉLICE		50	100
		Mecânico	Inspetor
CUIDADO: TOMAR UM CUIDADO EXTREMO AO GIRAR A HÉLICE COM AS MÃOS, A HÉLICE PODE RETROCEDER. ANTES DE GIRAR A HÉLICE, CERTIFIQUE-SE QUE AS CHAVES DE AMBOS OS MAGNETOS ESTÃO DESLIGADAS (ATERRADAS). SE OS MAGNETOS NÃO ESTIVEREM ATERRADOS, O GIRAR DA HÉLICE PODE ACIONAR O MOTOR.			
1	Inspeção o spinner e a placa traseira quanto a trincas, dentes, parafusos faltando e segurança.	<input type="checkbox"/>	<input checked="" type="checkbox"/>
2	Inspeção as pás quanto a entalhes e trincas.	<input type="checkbox"/>	<input checked="" type="checkbox"/>
3	Somente no PA-28-235, se a hélice instalada for de velocidade constante: cheque quanto a vazamentos de graxa e óleo.	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
4	Somente no PA-28-235, se a hélice instalada for de velocidade constante: lubrifique a hélice conforme a Carta de Lubrificação, Seção II.	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
5	Inspeção os suportes de instalação do spinner quanto a trincas e segurança.	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
6	Inspeção os parafusos de instalação da hélice quanto a segurança e frenagem. Verifique o torque e tome a aplicar a frenagem adequada caso freio esteja rompido.	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
7	Somente no PA-28-235, se a hélice instalada for de velocidade constante: inspeção as partes do cubo quanto a trincas e corrosão.	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
8	Somente no PA-28-235, se a hélice instalada for de velocidade constante: gre as pás da hélice e cheque quanto ao aperto no tubo guia do cubo. (Consulte a Seção III).	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
9	Inspeção toda a hélice e o spinner quanto a segurança, atrito, trincas, deterioração, desgaste e instalação correta.	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

Figure 9 - Service Order for the latest inspection of the PT-BOK aircraft.

NOMENCLATURA	CONTROLES / REFERENCIAS			TSN	TSG	CSN
	TLV	TBO	CBO			
HELICE	N/A	2 000,0 hrs	N/A	4647,9	1475,6	N/A

Figure 10 - Extract from the Component Control Map of 15 March 2022.

In addition to the fact that the data contained in the documentation shown above was inaccurate, the 100-hour inspection was logged in both propeller logbooks (SN K-26595 and SN K-13087), and, on the latter, a label was pasted stating that the information was not correct.

On 21 March 2022, during the accident flight, one of the propeller blades fractured, 13 hours and 10 minutes after the last inspection of the aircraft.

1.7. Meteorological information.

The METAR of SBBP contained the following information:

METAR SBBP 211200Z 15016KT 9999 FEW005 SCT100 19/14 Q1023=

METAR SBBP 211300Z 15018KT 9999 BKN026 20/14 Q1023=

METAR SBBP 211400Z 12019KT 9999 BKN026 BKN100 20/14 Q1024=

METAR SBBP 211500Z 15016G26KT 9999 BKN026 BKN100 21/15 Q1023=

According to recordings of the SBBP AFIS (Aerodrome Flight Information Service), the QNH at the time of takeoff was 1,023 hPa, while the wind direction and speed were respectively 150° and 15 kt.

Still in relation to the AFIS information, when the engine of the PT-BOK was started up, a wind of 8 kt was reported, and, just before takeoff, a wind of 22 kt.

Therefore, one verified that the visibility was more than 10 km, the ceiling was 2,600 ft, and wind speed was varying between 8 and 22 kt.

1.8. Aids to navigation.

NIL.

1.9. Communications.

From the AFIS recordings of SBBP, one verified that the crew maintained two-way radio contact with the ATS units up to the moment of frequency change (“instruction” position) for entering the planned flight area, without any technical abnormalities in the communication equipment during the flight.

1.10. Aerodrome information.

The site of the occurrence was not inside an aerodrome area.

1.11. Flight recorders.

Neither required nor installed.

1.12. Wreckage and impact information.

The impact occurred outside the aerodrome in an open area of a private gated-community.

The distribution of the debris was concentrated, and the aircraft traveled approximately 20 m on the ground before coming to a stop.



Figure 11 - Sketch of the wreckage.



Figure 12 - Marks of the first impact, and final position of the aircraft.

The flap control was in the down position. The elevator trim was in a pitch-up position; the rudder trim was in neutral, and the aircraft did not possess an aileron trim.

The speed recorded in the speedometer was approximately 62 kt (Figure 13).



Figure 13 - Indication of the speedometer found in the wreckage of the aircraft.

The propeller was painted black, and one of its blades had fractured (Figure 14).



Figure 14 - Fracture in one of the blades.

Inside the engine section, parts of the exhaust system were loose and fractured (Figure 15).



Figure 15 - Part of the exhaust pipes with signs of impact.

1.13. Medical and pathological information.

1.13.1. Medical aspects.

There was no evidence that issues of physiological nature or incapacitation might have affected the performance of the crew.

1.13.2. Ergonomic information.

NIL.

1.13.3. Psychological aspects.

There was no evidence that issues of psychological nature or incapacitation might have affected the performance of the crew.

1.14. Fire.

There was no evidence of fire (either in flight or after the aircraft stopped).

1.15. Survival aspects.

NIL.

1.16. Tests and research.

The fractured blade underwent analysis at the Institute of Aeronautics and Space (IAE) of the Department of Science and Aerospace Technology (DCTA).

The analysis revealed that blade had a fracture surface with characteristics typical of fatigue. The onset of the material fatigue process was fostered by the presence of a dent, which actuated as a stress concentrator.

In visual examinations, one observed plastic deformations of the propeller blade caused by several small impacts (points where paint was lacking - Figure 16), in addition to typical fatigue characteristics (Figure 17).

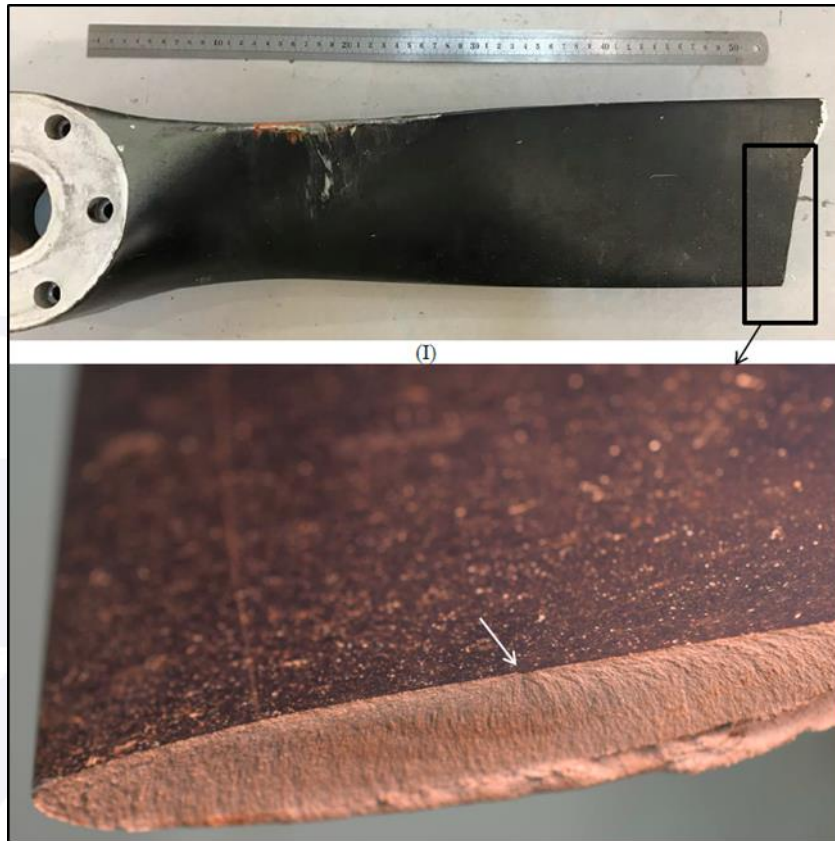


Figure 16 - Top image: overview of the fractured propeller. Lower image: detail of the propeller close to the fracture (The arrow indicates the point of the fatigue onset).

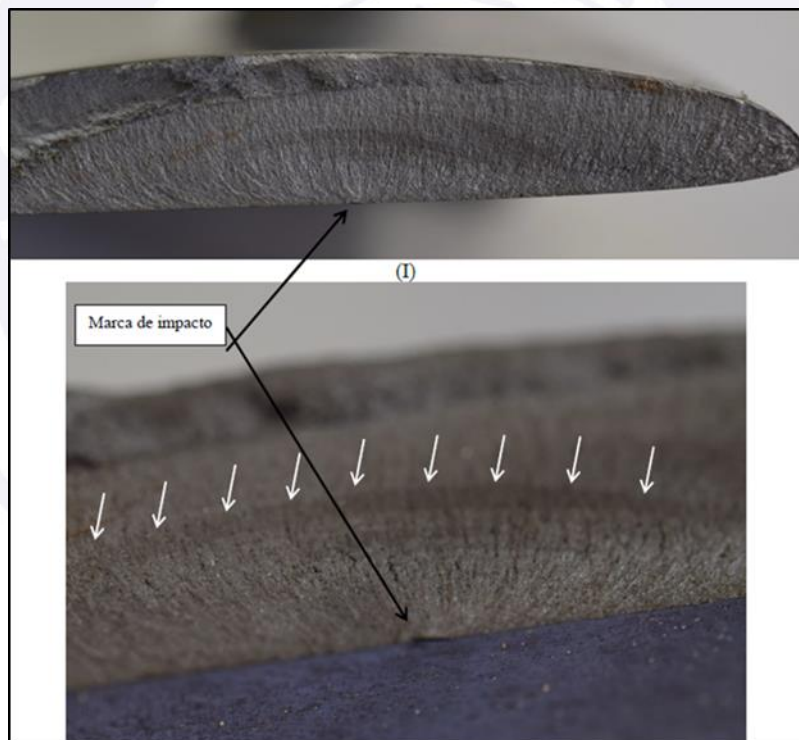


Figure 17 - Top image: precise point of the fatigue onset. Lower image, with further magnification: the white arrows indicate the advancement of fatigue from the expansion lines, aka *beach marks*.

Stereoscopic examinations showed the presence of plastic deformation caused by particle impact in the region where fatigue began to propagate (Figure 18).

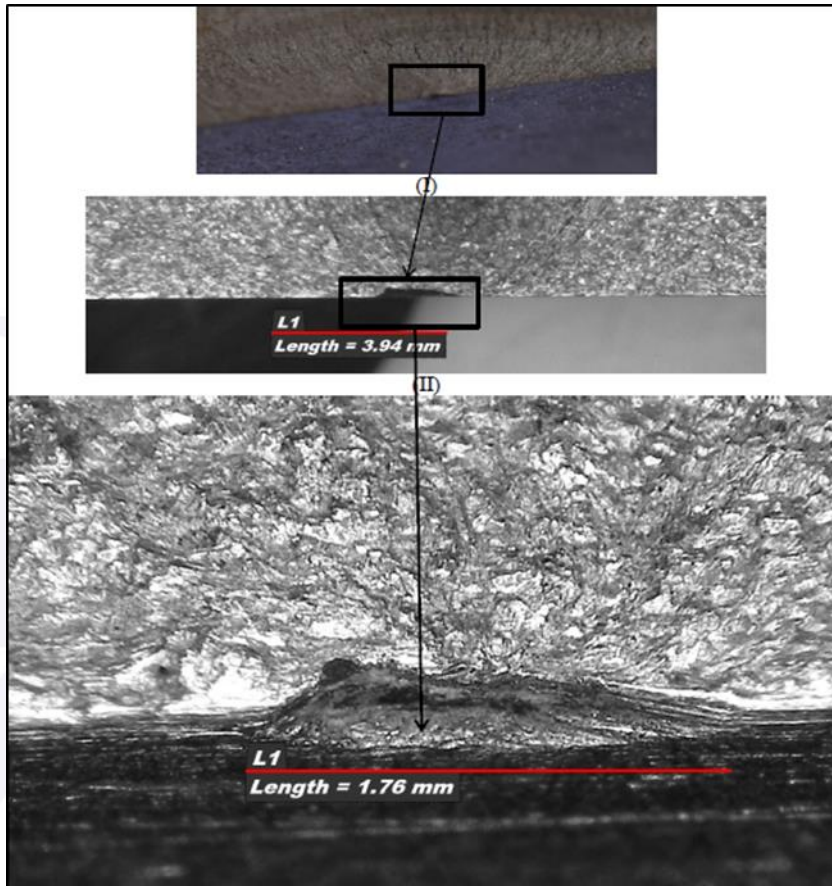


Figure 18 - Top image: detail of the spot where fatigue originated. Lower image: loss of material caused by impact (dent), acting as a stress concentrator that triggered the fatigue process.

Finally, the fractured propeller presented a fracture surface with typical characteristics of fatigue. The onset of fatigue process affecting the material was facilitated by the presence of a dent, which acted as a stress concentrator.

Approximately 50% of the blade lengthwise separated in flight.

1.17. Organizational and management information.

The aircraft operator was a Civil Aviation Instruction Center (CIAC), known as Charlie 0, and had the PA-28-140 PT-BOK and PT-DCW airplanes in its Operating Specification.

With regard to the requirements established in the RBAC-141, AMD01, "Certification and Operational Requirements: Civil Aviation Instruction Centers", the item (d)(2) of the section 141.45 read:

141.45 Aircraft requirements

(a) The CIAC type 2 or 3 must have at least one aircraft, under the conditions established in this section and available for instruction, during the entire period in which its certification is valid.

[...]

(d) Each aircraft used by the CIAC for the provision of flight instruction must:

(1) have a standard airworthiness certificate or special airworthiness certificate in the primary or light sport category and a valid registration certificate, issued by the ANAC; and

(2) be maintained and inspected in accordance with the applicable requirements of Subpart E of RBHA 91, or corresponding provisions that replace it.

Both scheduled and non-scheduled maintenance services were provided by *Marte Updates & Avionics Ltda.* maintenance organization - ME COM N° 1404-01/ANAC, in São Paulo, State of São Paulo.

One observed that there was not a close relationship between the operator and the maintenance organization, especially with regard to the controls of hours flown and their entries in the part I of the maintenance logbooks. The maintenance logbooks stayed in the maintenance organization, while the aircraft logbooks remained in the airplanes. Lack of communication caused the logbooks to remain out of date for long periods.

1.18. Operational information.

It was an instruction flight in the SBR-460 area in the region of *Bragança Paulista*, State of *São Paulo*. After leaving the AFIS frequency, in the “*instruction*” position, the pilots experienced an intense sudden vibration of the aircraft.

According to reports, the IN had the aircraft controls and requested that the PIC under supervision to shut down the engine using the mixture lever. However, due to the consequences generated by the intensity of the vibration, such control was no longer operative.

According to reports, the noise of the vibration was so loud that hindered clear communication between the crewmembers, and made it impossible to read the instruments on the panel.

The engine lost performance, and the IN directed the aircraft for an emergency landing. During the descent, the aircraft showed a strong tendency to roll to the left, and the IN had difficulty controlling the ailerons, using its entire course to the right to keep the aircraft flying. The flaps were lowered for landing.

Considering only flights in the period from November 2021 until the day on which the PT-BOK aircraft underwent the painting service, the SN K-26595 propeller flew for 35 days, and in 15 of them, the aircraft landed and took off from unpaved runways, meaning that in 42% of the days flown, the aircraft operated on dirt runways.

1.19. Additional information.

NIL.

1.20. Useful or effective investigation techniques.

NIL.

2. ANALYSIS.

In the course of an instruction flight, the crew experienced a sudden strong vibration of the aircraft, and had to make a forced landing in an area outside the aerodrome.

In the wreckage of the aircraft, one found a fractured blade of the propeller. The fractured blade was then sent to the IAE for analysis.

The information obtained from the analysis made it possible to conclude that the fracture occurred due to the formation of a dent, which actuated as a stress concentrator, leading to the collapse of the propeller, with an in-flight separation of approximately 50% of the affected blade along its length.

The data collected, however, did not suffice for one to determine the moment when the dent began to form.

In the analyses, it was also possible to observe that the soffit of the blade had several small points of impact, possibly resulting from FOD (Foreign Object Damage) on different occasions during the use of the propeller.

When analyzing the records of the last overhaul of the SN K-26595 propeller, one observed no visual damage, nor were there any deviations in its dimensional inspection. In the non-destructive tests with penetrant liquid, one found no discrepancies, with the propeller being declared in compliance with the continued-airworthiness requirements and approved for return to service on 25 August 2020.

Upon checking the aircraft logbooks and other maintenance records, one observed that, on 17 September 2020, the propeller passed the airworthiness verification inspection, being considered fit for flight. In the period the propeller equipped the PT-DCW aircraft, a 50-hour maintenance service was not logged in the SN K-26595 propeller logbook.

On 02 December 2021, the maintenance staff removed the propeller from the PT-DCW, and installed it on the PT-BOK aircraft.

During the provision of the propeller exchange service between the two aircraft, it was not possible to verify whether the SN K-26595 propeller was inspected, taking into account that the service in PT-BOK began on 01 December 2021 and that the PT-DCW aircraft landed at SBMT, for the propeller exchange, only on 02 December 2021, at 15:44 UTC.

According to the inspection logbook, the first planned tasks during the inspection were related to checking the condition of the aircraft's propeller. This way, the maintenance team may have performed such tasks before the replacement.

Furthermore, the inspection records were logged in the logbook of the propeller removed, but no inspection records were logged in the logbook of the SN K-26595 propeller. Although there is a possibility that the propeller was inspected before being installed, it is possible that this did not happen at that time, because of the time line and records found in the logbooks.

After the exchange of the propellers, between 03 January 2022 and 10 February 2022, one found that the aircraft underwent a painting service done by a professional not certified by the ANAC, and without the assistance of qualified staff to inspect the service being provided. In addition, in that general painting, according to reports, the aircraft was painted without removal of the SN K-26595 propeller.

In accordance with the RBAC-91 (AMD03, section 91.423, letter c, item 2), after an aircraft is subjected to maintenance services and changes that may have altered its weight, a checking service has to be performed in order to assess the aircraft's new weight & balance limitations.

In that respect, no updated weighing form was presented, with the CIAC using a form dated from 04 June 2007.

After the exchange of propellers, there was no mention of the 50-hour inspection in the logbook of the SN K-26595 propeller.

On 15 March 2022, the aircraft underwent a 50- and a 100-hour inspection, in which the records contained in the Service Order and the Component Control Map referred to the SN K-13087 propeller (which had been replaced), generating unreliable maintenance information, and revealing inadequate control of the items inspected.

A few annotations found in the maintenance documentation raised doubts as to whether or not the inspections of SN K-26595 propeller were carried out. Regardless of the doubts, one verified that some maintenance services were no longer being performed. In such circumstances, the probability of detection of a dent in the propeller may have been reduced.

Finally, there is the possibility that touch-ups were made on the blades, and that they could have filled and "camouflaged" the dent, contributing to a less accurate inspection in the maintenance performed on 15 March 2022.

3. CONCLUSIONS.

3.1. Findings.

- a) the IN and PIC under supervision held valid CMAs (Aeronautical Medical Certificates);
- b) the IN had valid MNTE, MLTE, IFRA, and INVA ratings;
- c) the PIC under supervision held valid MNTE and IFRA ratings;
- d) both pilots were qualified, and the PIC under supervision was doing his third instructional session of the *aircraft flight-instructor preparation course*;
- e) the aircraft had a valid CVA (Airworthiness Verification Certificate);
- f) the records of the airframe, engine, and propeller logbooks were not up to date;
- g) the meteorological conditions were suitable for the flight;
- h) the aircraft took off for a local instruction-flight;
- i) a blade of the propeller fractured in flight;
- j) the aircraft sustained strong vibration and loss of performance of its engine;
- k) the crew made an emergency landing in an open area;
- l) one verified that, on 02 December 2021, the SN K-26595 propeller had been removed from the PT-DCW aircraft and installed on the PT-BOK;
- m) on the date of installation of the SN K-26595 propeller on the aircraft, there were no records related to its inspection logged in the respective logbook;
- n) at least one 50-hour inspection of the propeller was not executed;
- o) without supervision, the aircraft was painted by a professional not certified by the ANAC;
- p) after the general painting, the aircraft did not undergo a weight-and-balance procedure;
- q) in the last 100-hour inspection, the Service Order and Component Control Map records contained data of a propeller that had already been removed;
- r) the propeller blade had a fracture surface with characteristics typical of fatigue;
- s) the onset of the fatigue process of the propeller material was facilitated by the presence of a dent, which actuated as a stress concentrator;
- t) one was not able to determine when the dent of the propeller blade began to develop;
- u) the aircraft sustained substantial damage; and
- v) the IN and the PIC under supervision suffered serious injuries.

3.2. Contributing factors.

Aircraft maintenance – undetermined.

The processes for effective verification of the serial numbers of the parts undergoing inspection were not set up in a proper way, allowing errors in the logbooks, and generating unreliable information. Furthermore, the maintenance logbooks were out of date, while other types of documentation contained erasures, and the aircraft underwent painting in an irregular fashion.

Management planning – undetermined.

One observed that the planning of the maintenance activities was not appropriate, allowing gaps (discontinuity) between scheduled inspections. Moreover, the planning of the aircraft's painting process was inadequate, without due attention to the regulations in force, something that may have compromised the airworthiness the airplane.

Managerial oversight – undetermined.

The maintenance logbooks, with outdated information for more than two years in a row, evidenced failure in the supervision of the administrative processes necessary for preserving the reliability of the records. Such state of affairs may have led to the lack of proper inspections of the propeller, and consequent detection of the initial dent of the fracture.

4. SAFETY RECOMMENDATIONS

A proposal of an accident investigation authority based on information derived from an investigation, made with the intention of preventing accidents or incidents and which in no case has the purpose of creating a presumption of blame or liability for an accident or incident.

In consonance with the Law n°7565/1986, recommendations are made solely for the benefit of safety, and shall be treated as established in the NSCA 3-13 “Protocols for the Investigation of Civil Aviation Aeronautical Occurrences conducted by the Brazilian State”.

To Brazil's National Civil Aviation Agency (ANAC):**A-036/CENIPA/2022 - 01****Issued on 01/23/2024**

Work with the *Marte Updates & Avionics Ltda.* - ME (COM N° 1404-01/ANAC), in order to ensure that their management processes are based on current regulations, seeking to ensure that their maintenance procedures are compliant.

A-036/CENIPA/2022 - 02**Issued on 01/23/2024**

Work with *CIAC Charlie 0-Aeronautical Training Center Ltda.* in order to ensure that the criteria for maintaining the weight and balance limits of their aircraft are compliant with current regulations.

5. CORRECTIVE OR PREVENTATIVE ACTION ALREADY TAKEN.

None.

On January 23th, 2024.